

REPORT DOCUMENTATION PAGE

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Final Technical Report
Defense University Instrumentation Research Program

Grant Number F49620-99-1-0145

MIG Electron Gun for Megawatt Ka-Band Gyrotron Amplifiers

Sponsored by
Air Force Office of Scientific Research/NE

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Final Technical Report

Following the initial submittal of the W-Band millimeter wave source electron gun proposal, several events occurred which, following consultation with the Technical Monitor, resulted in a slight departure from the originally envisioned electron gun. The first was the offer by NTHU to provide gratis the major components for the fabrication of a MIG gun for our 94 GHz gyro-TWT. Figures 1 and 2 are photographs of the constituent parts which have subsequently been received at UC Davis and which are awaiting final assembly. The second major event was the emergence of the W-Band klystrino concept as perhaps the most important result from the MURI HPM program. It was therefore determined that it was essential to purchase an electron gun to perform the critical tests of the focussing and transport issues since AFRL/Phillips Lab is preparing to fund the development of a complete device. We therefore placed a purchase order with Stanford for the fabrication of the gun and also purchased a major work station for the gun modelling and simulation.

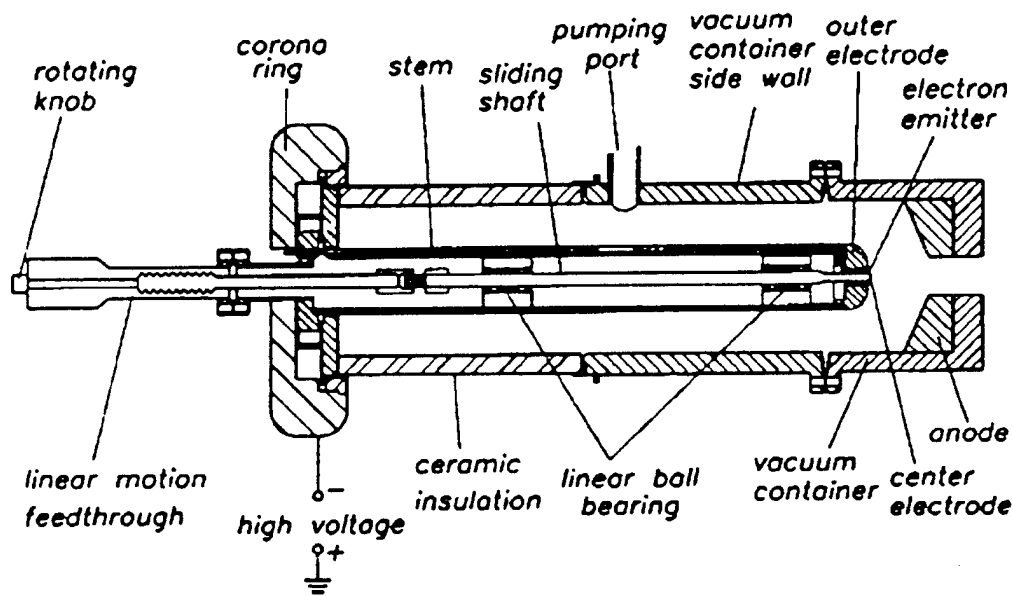


Figure 1 Side view of the essential portion of the NTHU mechanically tunable single-anode MIG provided to UC Davis for W-Band Gyro-TWT Studies.

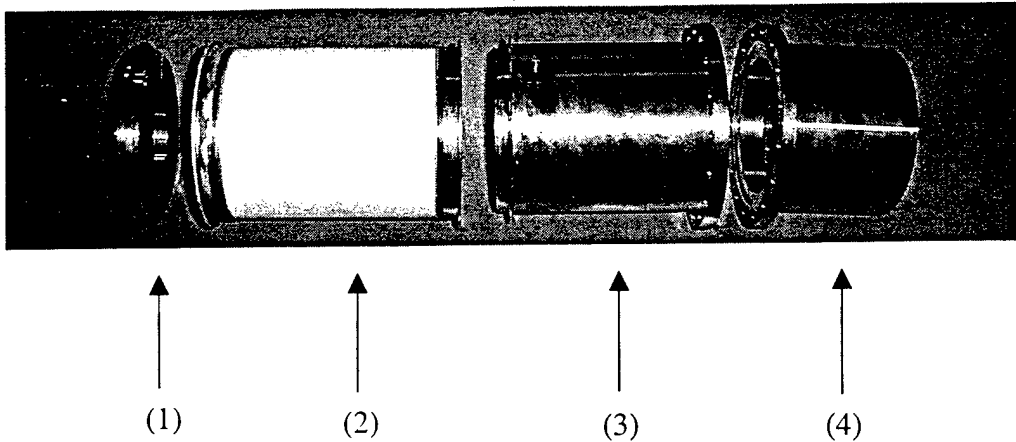


Figure 2 (1) The annular metal disk (stainless steel), (2) ceramic insulation (brazed to Kovar rings at both ends), (3) the vacuum container side wall (stainless steel), (4) the vacuum container (stainless steel). These parts can be used for either fixed or mechanically tunable MIGs.

The equipment purchased with the 1999 DURIP contract # F49620-99-1-0145 is listed below.

Equipment and Vendor	Cost
W-band electron gun and ultra-high-vacuum chamber Stanford Linear Accelerator Center	\$149,950.68

The W-band electron gun and vacuum system is to be used in evaluation of beam focusing and beam transport issues that arise during the development of high average power millimeter wave sources. The complete assembly will be used as a testbed for a variety of PPM focusing systems as well as various millimeter wave RF circuits. The vacuum system has multiple ports to provide waveguide input and output, beam diagnostics, water cooling, optical viewports, and high-throughput vacuum pumping.

Figure 3 shows the vacuum chamber and associated hardware. The chamber is designed to support cathode voltages up to 150 kV. The electron gun uses an isolated focus electrode to provide external control of the fields at the edges of the convergent electron beam. The cathode, shown in Fig. 4, is an M-type dispenser cathode manufactured by SpectraMat. The electron gun is designed to operate at 110 kV and 2.5 A. The cathode diameter is 4.5 mm and the final beam diameter is 0.5 mm for an area convergence of 81.

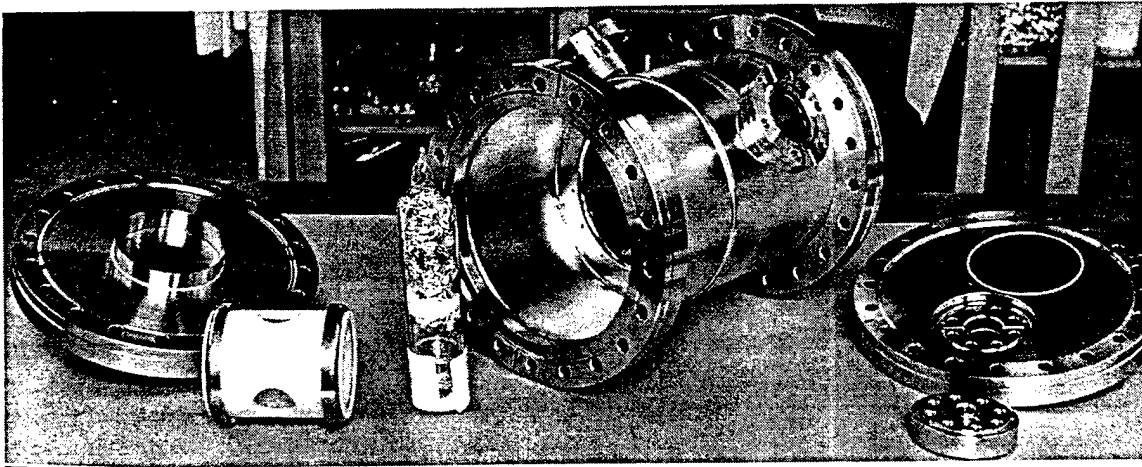


Figure 3 Components for millimeter wave gun and vacuum chamber. The machining for the inverted vacuum flange can be seen on the 8" diameter base plate on the right of the photograph

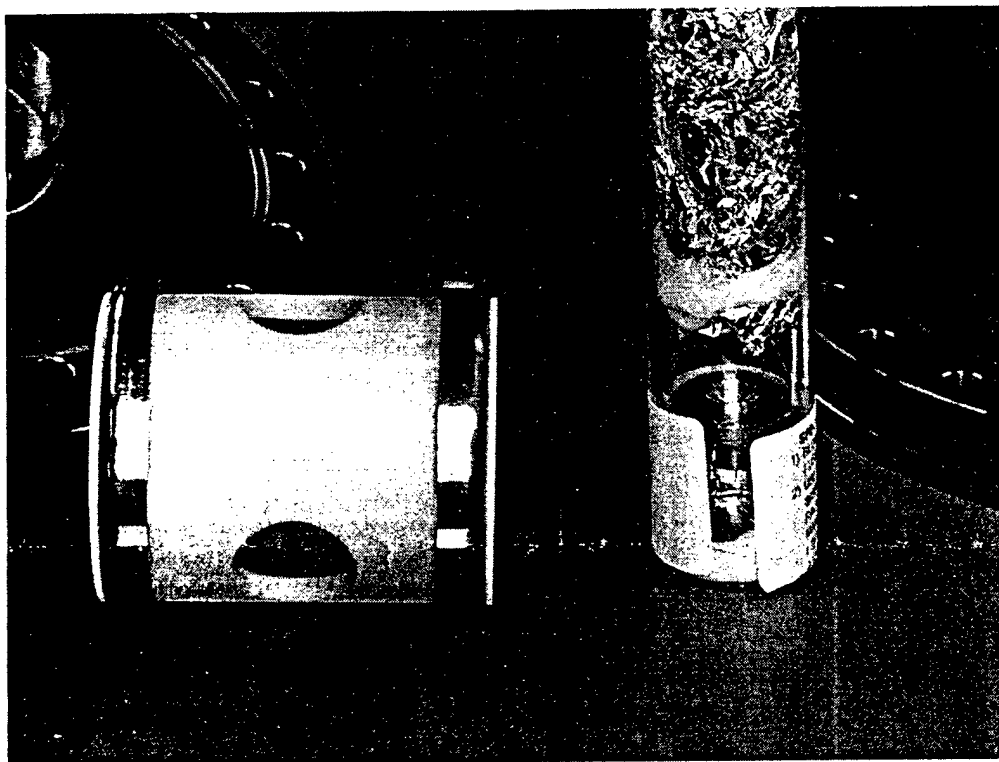


Figure 4 Photograph of the high voltage insulator and the dispenser cathode in its nitrogen-filled glass transport container.

The arrangement of components in the vacuum chamber is shown in the solid model in Fig. 5. The device being tested is assembled on the base plate of the vacuum chamber. The figure shows a periodic permanent magnet assembly mounted on the base prior to testing.

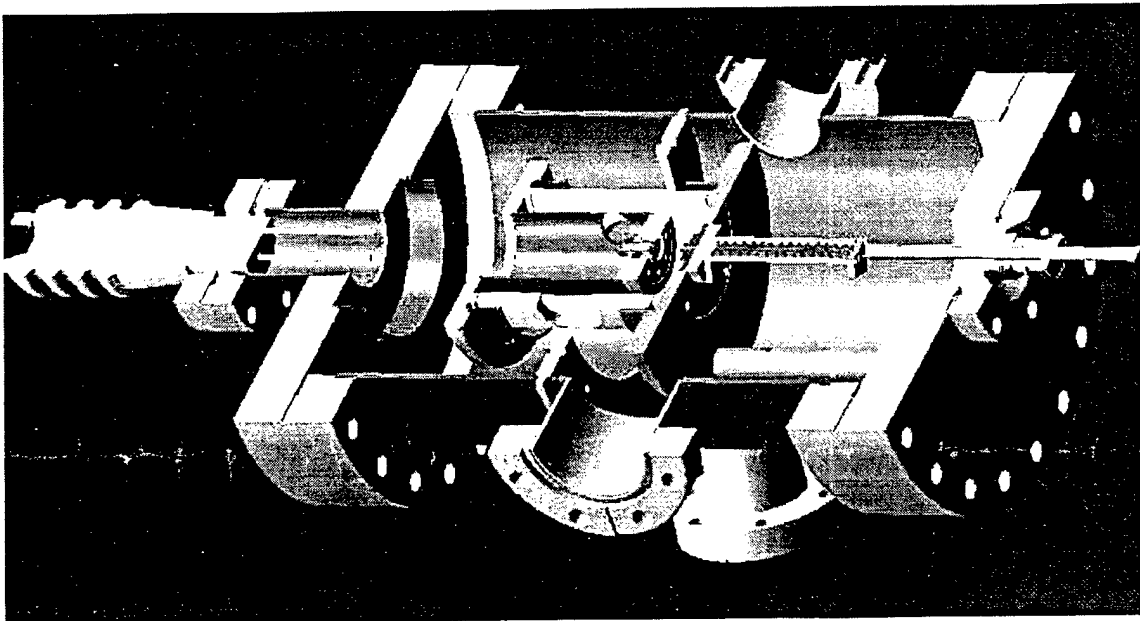


Figure 5 Solid model cutaway view of PPM beam test setup.

Equipment and Vendor	Cost
Sun Microsystems Model E450	\$30,878.15
Server and Options for E450	
Sun Microsystems and US Telesales	

Equipment and Vendor	Cost
HP Color Laserjet 4500N Printer	\$2,926.85
Inacomp Computers Centers	